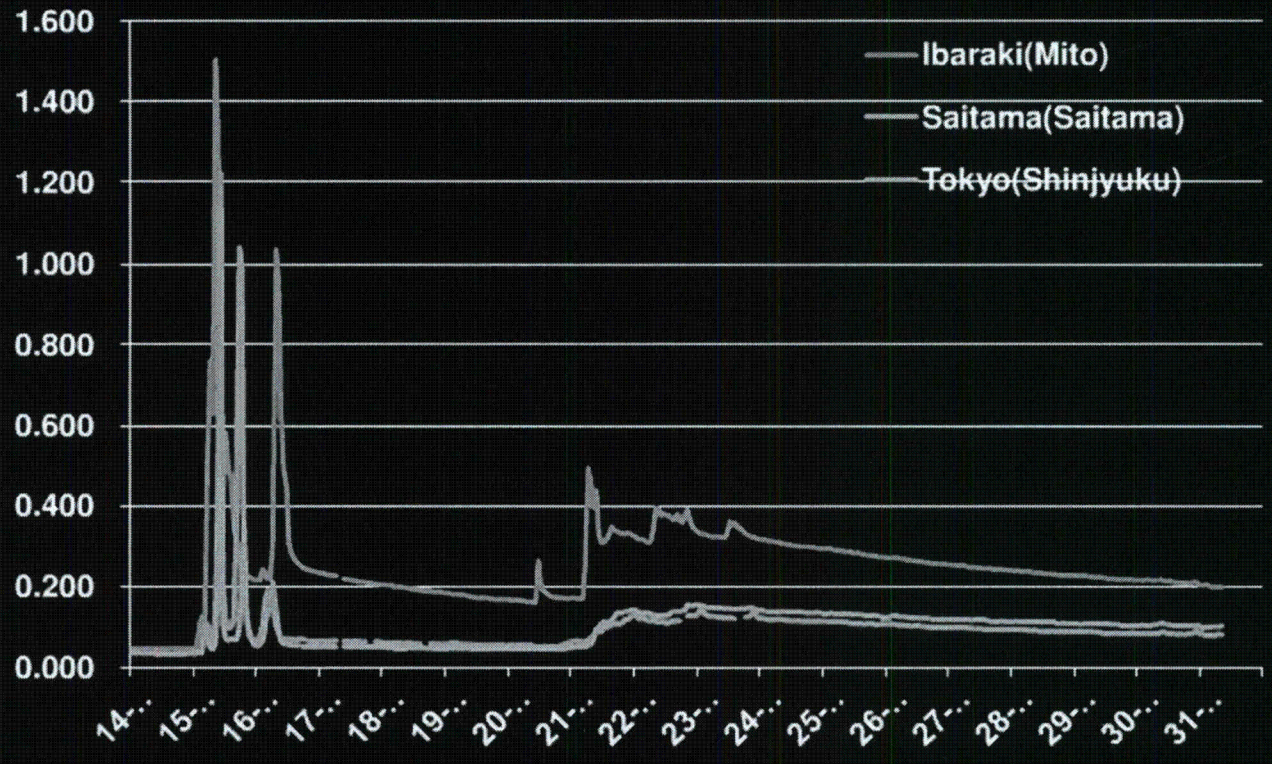
Fukushima Nuclear Accident

Radiological Monitoring and Consequences

April 1, 2011

Gamma Dose Rates in µSv/hour
14-31 March



Natural Background: 0.1 µSv/hour: continue to decrease

Measurements of the IAEA team

March, 31- April 1, Fukushima Team1 and 2

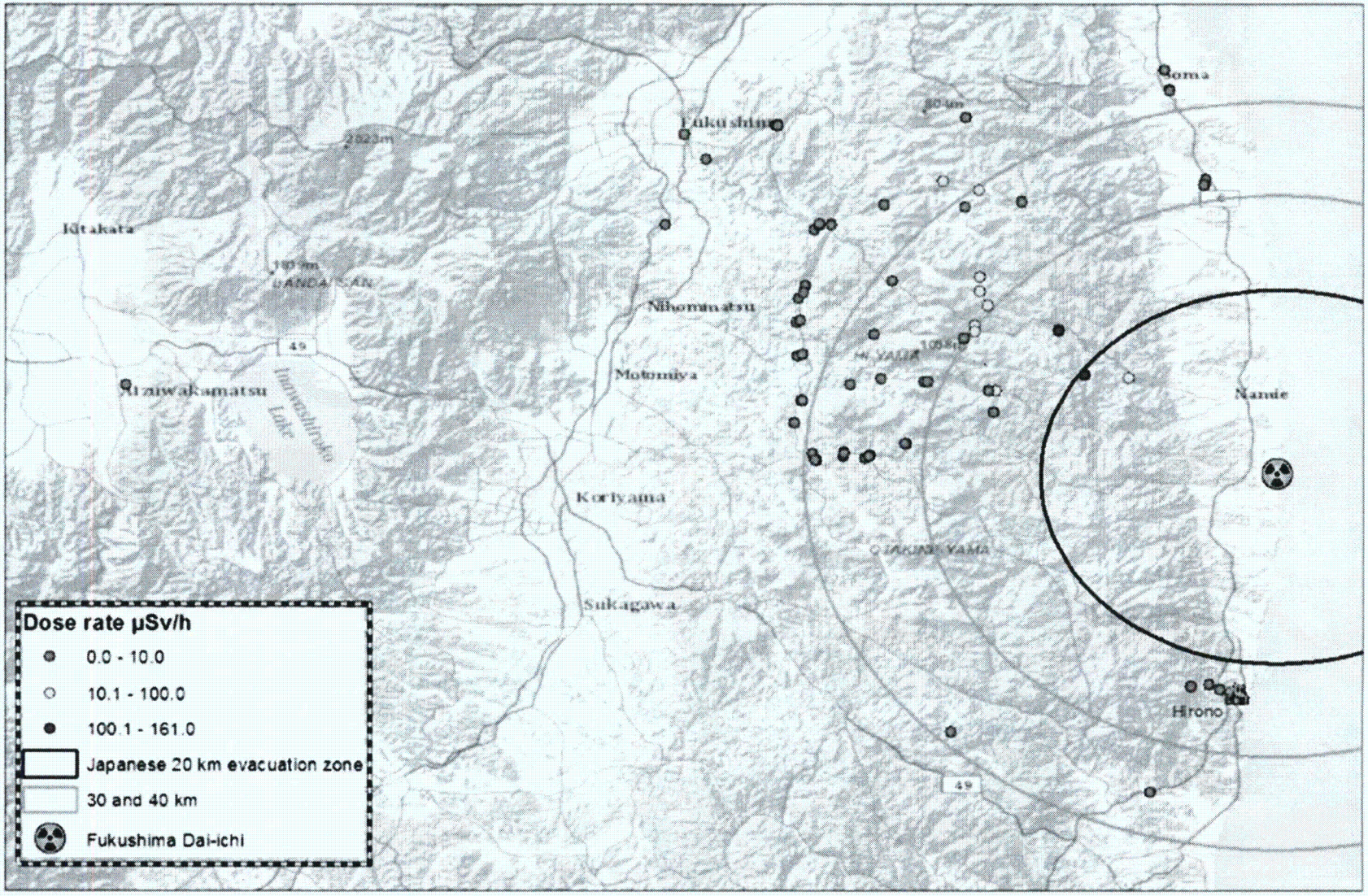
- 1 April, FT2 and FT3 altogether as succession process.
- 7 different points of radius of 23 to 58 km from the Fukushima NPP
- Dose rates: 0.4 to 5 µSv/h
- Beta-gamma contamination: 0.01 to 0.49 MBq/m^2
- Several gamma spectra, air samples and smears collected
- No alpha particles detected in the air.
- 2 April, FT2 back to Tokyo, and then to Vienna

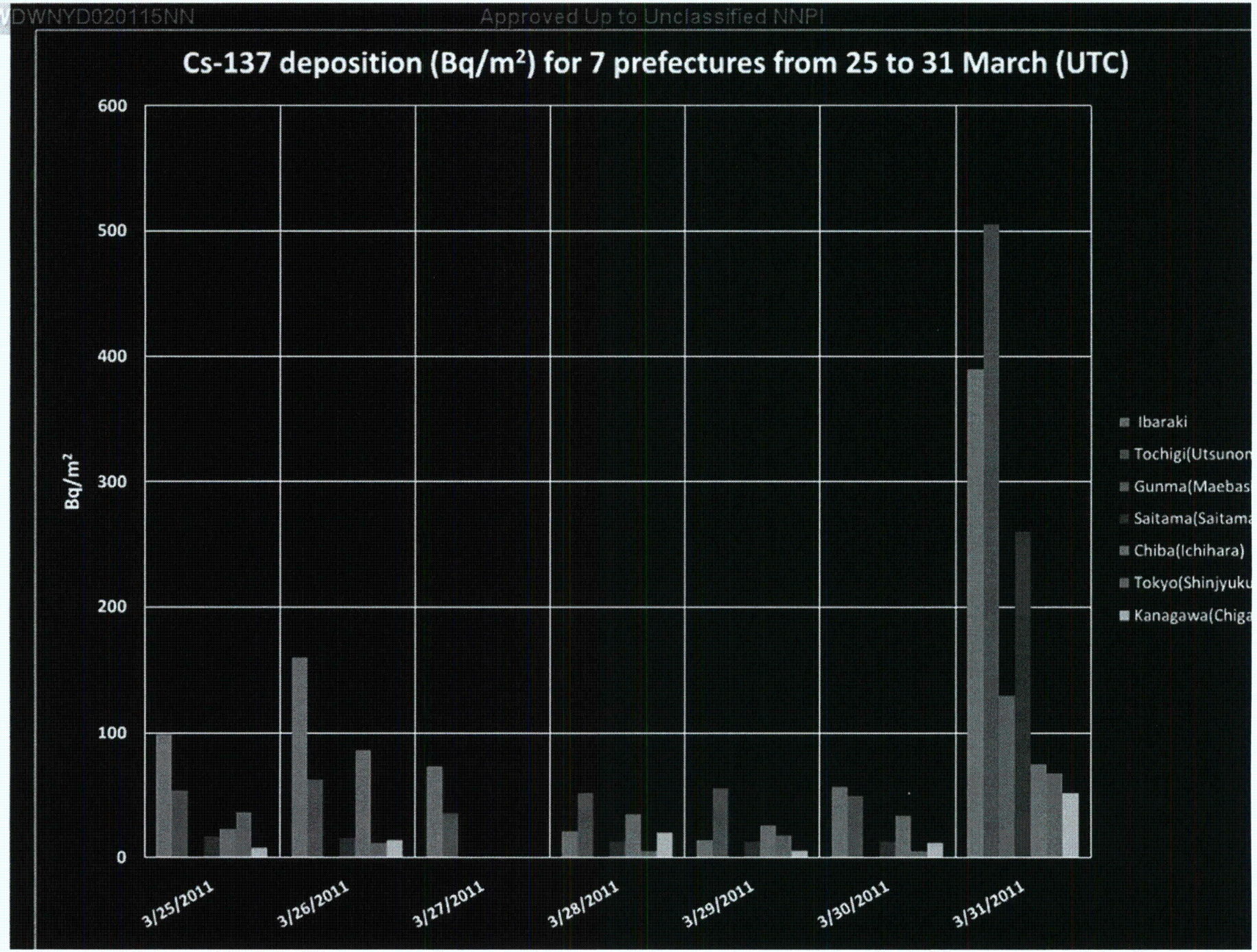
March 31, Tokyo team

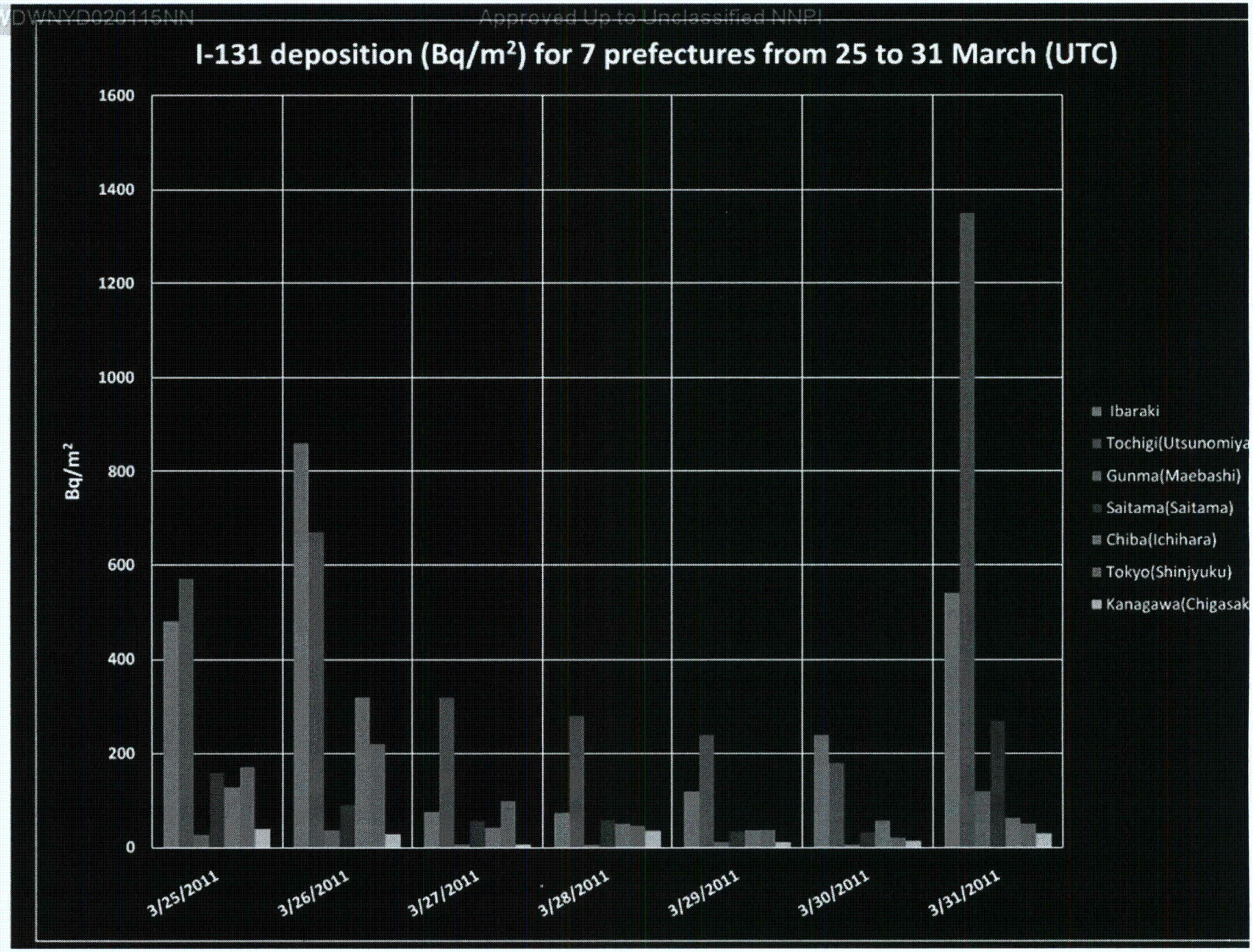
- 31st was the last day for Tokyo-team

IAEA Field Team Measurements up to 2011-03-31

Team Fukushima







Monitoring of Workers 29 March

- **Nuclear and Industrial Safety Agency's report:**
  - 106,095 people in Fukushima
  - 102 above 100,000 counts per minute (cpm)
  - Levels decreased after removal of clothes
  - No cases that may influence health
- Among workers at Fukushima NPP:
  - 20 workers exceeded 100mSv
  - (Dose limit for emergency workers in life saving operation: 250 mSv)

Monitoring of drinking water 28 March

- Recommendations for restrictions on drinking water being lifted in most locations.
- Recommendations for restrictions based on I-131 concentration remain in place in 4 locations of Fukushima prefecture.

Radioactivity in Foodstuffs

- Results reported 31 March by the Japanese Ministry of Health, Labour and Welfare

- 98 of the 111 samples for various vegetables, fruit, seafood, various meats and unprocessed raw milk
- in 8 prefectures (Chiba, Fukushima, Gunma, Ibaraki, Kanagawa, Niigata, Tochigi, and Tokyo),
- I-131, Cs-134 and Cs-137 were either not detected or were below the regulation values set by the Japanese authorities.

Radioactivity in Foodstuffs

- 13 of the 111 samples:
  - for spinach and other leafy vegetables, parsley and beef
  - in Chiba, Fukushima, Ibaraki and Tochigi prefectures indicated that I-131 and/or Cs-134 and Cs-137 exceeded the regulation values set by the Japanese authorities.

Discussion concerning soil

- The Japanese Agriculture Ministry has announced on 30 March the need to establish acceptable levels of radioactive Cs in soils to help farmers to decide whether to plant crops.
- Fukushima prefecture conducted a survey of soil from farmlands on 31 March.

Joint FAO/IAEA Food Safety Assessment Team

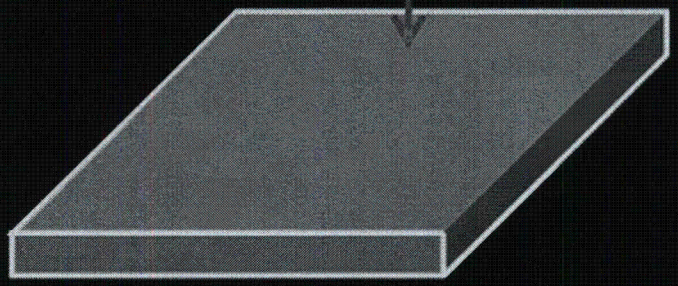
- The Joint FAO/IAEA Food Safety Assessment Team has successfully completed its mission.
- The team presented its report to the Japanese Cabinet Office, Ministry of Foreign Affairs, Ministry of Health, Labour and Welfare and the Ministry of Agriculture, Fisheries and Forestry on 31 March.
- The IAEA members of the Team are returning to Vienna today.

From Bq/kg to Bq/m^2

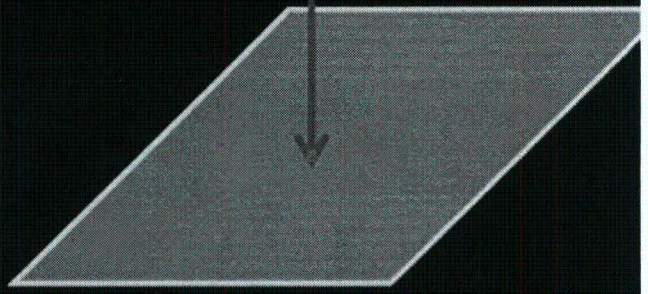
- Soil sample taken with a device that penetrates the ground at the depth of 5 cm
- Measurement of radioactivitiy within the sample, using a spectrometer
- Result: Radioactivity in Bq/kg
- Conversion from Bq/kg to Bq/m^2 depends on:
  - Radioactivity (Bq/kg)
  - Soil density (kg/m^3)
  - Sample depth (m)

Assuming a homogeneous distribution of radioactivity within tha aera considered

Radioactivity in soil
Bq/kg



Average soil surface contamination
Bq/m^2



Radioactivity (Bq/kg)x Soil density (kg/m^3)x sample depth (m)
= Surface contamination (Bq/m^2)

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East Japan Great Earthquake Damage Report

7 APR 0830 (Thu)

Japan Defense Intelligence Headquarters

East Japan Great Earthquake

JDIH
7 APR 2011 (Thu) 0830

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Earthquake Overview

- 11 MAR 1446, M9.0 Earthquake occurred off the coast of Sanriku Region, Intensity 7 (Japanese scale, Northern Miyagi)
- Aftershocks: 6 APR Japan Meteorological Agency predicts a 10% chance of a intensity 5+(M7.0) quake by 12 APR 1500
  There will be a predicted 20 aftershocks that are above M5.0 before 12 APR
  6 APR 2156 M4.7 quake in northern Ibaraki. Max intensity 4 (Hitachi city)
  6 APR 1155 M5.3 quake off the coast of Fukushima. Max intensity 4 (South Miyagi)

Damage overview (6 APR 2000)
(±compared to 6 APR 1345)

- Deaths: 12,554 (+66)
- Missing: 15,077 (-69)
- Injured: 2,866 (-19)
- Displaced : App. 160,600 (-1,500)
  Miyagi (App. 61,000)
  Fukushima (App. 26,100)
  Iwate (App. 50,200)

Damage to Lifeline (5 APR 1600)

- Electricity: Outage at 163,000 homes (-2,000)

(Iwate: 30,000, Miyagi: 97,000, Fukushima: 36,000)

Power Outages:
Tokyo Electric: No outages until the 11th
Tohoku Electric: Not today

- Water: Outage: 132,000 (-7,000)
- Gas: Outage: 169,000 (-21,000)

- Fukushima Daiichi Nuclear Power Plant (5 APR 0800)

11 MAR Nuclear Emergency Declared
12 MAR Ordered the evacuation 20km radius
15 MAR 20-30km residents asked to stay indoors
27 MAR Water found in trenches outside of reactor 1-3
The water near reactor 2 was 1,000mSv/h.
31 MAR iodine detected at 4,385 times the standard in seawater near the south water discharge port
2 APR Water in the pit near water intake port registered over 1000mSv/h. Crack found in concrete on wall.
4 APR Released low-contamination water from the central contaminated waste treatment facility and reactor 5, 6.
6 APR 0530 stopped the leak of contaminated water from the pit of reactor 2
6 APR 1800 Reactor 1 Containment Structure Temp 211.2 ℃ (compared to 5 APR 0000: -26.2℃)
6 APR 2230 Injected Nitrogen into Reactor 1

Damage to Infrastructure (6 APR 1800)

- Roads: 2,126 damaged areas (56 damaged bridges); 1 Expressway and 17 national highways blocked; other than a few restricted areas, all roads are open for private and commercial vehicles.
- Rail: Most JR and private railways are operational in the Tohoku area. Akita Yamagata Shinkansen restored
- Air: All airports operational
- Ports: All ports are partially operational. More Berths available at Kuji and Sendai Shiogama Port

Red font: Changes from the last report

Human Loss

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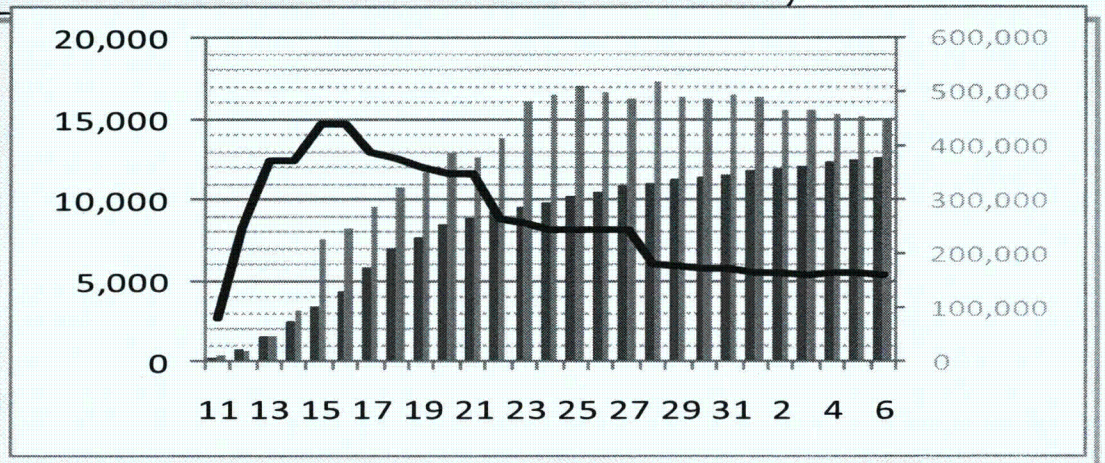
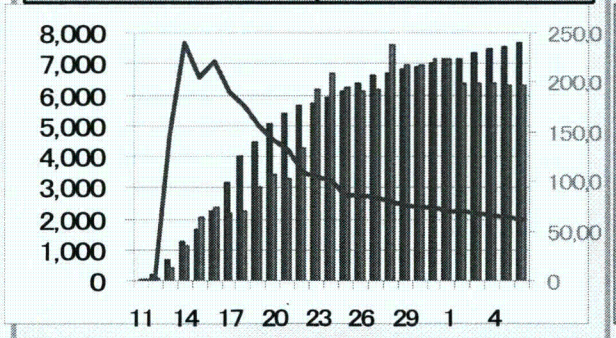
Totals (Includes Kanto)	
Deaths	12,554 (+66)
Missing	15,077 (-69)
Displaced	App. 160,600 (-1,500)

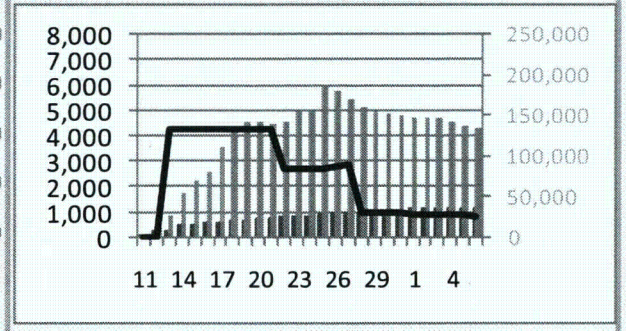
(Numbers in () show difference from 6 APR 1345)



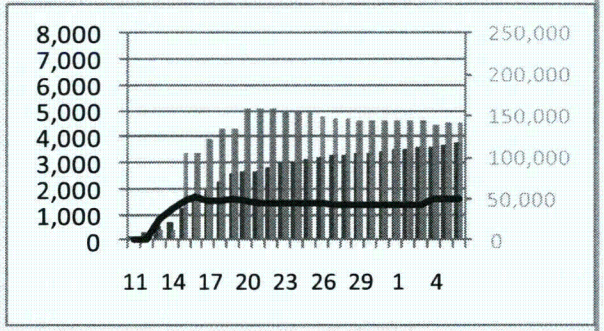
Miyagi	
Deaths	7,648 (+41)
Missing	6,321(+ 6)
Displaced	App. 61,000 (-2,000)



Fukushima	
Deaths	1,158 (±0)
Missing	4,280(±0)
Displaced	App. 26,100(-400)



Iwate	
Deaths	3,687(+44)
Missing	4,472(- 30)
Displaced	App. 50,200 (+1,200)



Source: NPA/Prefectural Govs

Nuclear Power Plants

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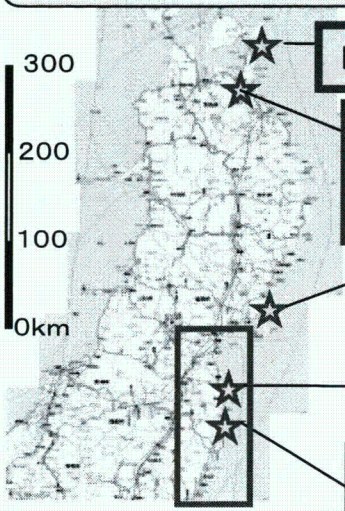

- Higashi Dori NPP — Under Inspection
- Rokkasho Reprocessing Plant — Operational
- Onagawa NPP — Shutdown
- Fukushima Daiichi — Evacuation Orders
- Fukushima Daini — Evacuation Orders

Fukushima Daini Nuclear Power Plant: Cold Shutdown

- ◇ 12 MAR 0745 Evacuation Order 10km radius
- ◇ Radioactive Materials Released?: No
- ◇ Displaced Persons: 32,426 (10km radius)
- ◇ 30 MAR 1756 Smoke at Reactor 1, at 1915 FD determined that there was an equipment malfunction and that it wasn't a fire

Source: Emergency Disaster Relief Headquarters

Fukushima Daiichi Nuclear Power Plant

- ◆ 11 MAR 1903 Nuclear Emergency Declared
- ◆ 12 MAR 1825 20km radius evacuation order (180,000 affected)
- ◆ 15 MAR 1100 20km-30km residents asked to stay indoors
- ◆ 15 MAR 1410 30km radius no-fly zone declared (MLIT)
- ◆ 18 MAR INES provisional assessment of situation released
  - ◇ Reactor No. 1, 2, 3: Evaluation Level 5 (Accident with Widespread Consequences)
  - ◇ Reactor No. 4: Evaluation Level 3 (Serious Incident)
- ◆ 20 MAR Cooling systems restored to Reactors 5 and 6. Cold Shutdown
- ◆ 22 MAR Reactor 1-4: Connected to external power. Inspecting equipment.
- ◆ 24 MAR 1537 Power/Cooling to Spent Fuel Pool
- ◆ 25 MAR Freshwater to Reactor 1, 3 Cores, 26 MAR Reactor 2
- ◆ 27 MAR Radiation levels of turbine bldg basement water pool are 1000mSv/h for Reactor 2, and 750mSv/h for Reactor 3
- ◆ 27 MAR Found water in trenches outside of reactors 1-3. Radiation levels of water outside of Reactor 2 turbine bldg is 1000mSv/h
- ◆ 28 MAR TEPCO finds traces of Plutonium within facility
- ◆ 2 APR Water in the pit near water intake port registered over 1000mSv/h. Water leaking into pit from crack in concrete wall.
- ◆ 3 APR Complex Molecular Polymer poured into reactor 2 pit to stop water flow.
- ◆ 4 APR Low-contamination water released from central contaminated water treatment facility and reactor 5 & 6
- ◆ 6 APR Stopped the contaminated water leak from the pit of reactor 2
- ◆ 6 APR 2230 Injected Nitrogen into Reactor 1

Red: Updated Information Blue: Officially Unreleased New Information

Fukushima Nuclear Powerplant

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	Reactor 1	Reactor 2	Reactor 3	Reactor 4	Reactor 5 & 6
	INES Level 5			Level 3	
Major Incidents	11 MAR 1636 Cooling System Failure 12 MAR 1536 Hydrogen Explosion 22 MAR 1120 Reactor Vessel temp rises (383 ℃) 23 MAR~ Temperature in reactor vessel declining (146.3℃ as of 26 MAR 0930) 27 MAR Turbine Bldg Pool Water Radiation Levels: 60mSv/h	11 MAR 1636 Cooling System Failure 14 MAR 1325 Loss of Cooling Capability 15 MAR 0610 Explosive Sound heard. Suppression Pool Damaged? 27 MAR Turbine Bldg Pooled Water Radiation Levels: 1,000mSv/h 28 MAR Water outside Turbine bldg is 1,000mSv/h **2 APR Water in the pit near water intake port registered over 1000mSv/h. Water leaking into pit from crack in concrete wall.**	13 MAR 0856 Cooling Failure 14 MAR 1101 Hydrogen Explosion 21 MAR 1555-1802 Grey smoke 23 MAR 1620 Black smoke (stopped 2330) 24 MAR radiation injury to 3 people at turbine bldg. 2 hospitalized 27 MAR Turbine Bldg Pooled Water Radiation Levels: 750mSv/h	14 MAR 0408 Temp rise in Spent Fuel Pool (Normally 40℃) 15 MAR 0938 Fire (extinguished 1225) 16 MAR 0545 Fire (extinguished 0726) 27 MAR Turbine Bldg Pooled Water Radiation Levels: 0.5mSv/h	15 MAR 1600 Temp rise in Spent Fuel Pool of Reactor 5 and 6 20 MAR Reactor 5 & 6 Cold Shutdown (Core under 100 ℃) 23 MAR 1724 Cooling Pump Failure (Repaired 3/24)
Damage	Roof of the outer structure damaged	East side of outer structure has a hole.	・Only the reinforced steel remain for the roof	・Only the reinforced steel remain for the roof	No visible damage
Electrical	Power from Reactor 2. Inspecting equipment 24 MAR Light in Cent Cont Rm	External Power Connected. Inspecting equipment 26 MAR Light in Cent Cont Rm	Power from Reactor 4. Inspecting equipment 22 MAR Light in Cent Cont Rm	External Power Connected. Inspecting equipment. 29 MAR 1150, Lights turned on in the central operating room	External Power Connected. Switched power sources.
Current Status	・Water level: A: -1,650mm (+50) B: -1,650mm (+0) (as of 6 APR 1800: Compared to 5 APR 0600) ・Reactor Core Damage 70%(15 MAR 1530) 211.2 ° C (6 APR 1800)	・Water Level: -1,500mm(+0mm) (as of 6 APR 1800: Compared to 5 APR 0600) ・Reactor Core Damage 30%(15 MAR 1530) 143.6 ° C (6 APR 1800)	・Water Level: A:-1,800mm (+50mm) B:-2,200mm (+50mm) (as of 6 APR 1800: Compared to 5 APR 1020) ・Reactor Core Damage 25%(14 MAR 0635) 83.0 ° C (6 APR 1800)	No fuel rods	Cold Shutdown
Spent Fuel Pool	Water temp: not measurable *Water temp: 24 ° C (6 APR 0730: MOD measurement)	Water temp: 51℃ (-20℃) (as of 6 APR 1800: Compared to 5 APR 0600)	Water temp gauge: broken MOD measured temp: 60 ℃ (+3.0) (as of 6 APR 0730)	Water temp: not measurable MOD measured temp: 57 ℃ (+27) (as of 6 APR 0730)	Water Temp: Reactor 5: 31.3℃(-3.9℃) Reactor 6: 28.0℃(+2.0℃) (as of 6 APR 2000: Compared to 5 APR 1300)

Red: Updated Information Blue: Unreleased New Information **Source: Nuclear Powerplant Disaster Response Headquarters**

Detailed Report of the Fukushima Nuclear Powerplant

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	Reactor 1	Reactor 2	Reactor 3	Reactor 4	Reactor 5 & 6
Countermeasures	12 MAR 1430 Vent Reactor 12 MAR 2020 Seawater Pumped 19 MAR Power estimated to be restored ・Completed laying the cable from external power line to the power plant backup transformer. Currently connecting power to motor and other equipment. 23 MAR 0233 Pumped water into reactor using the built in pipes. 25 MAR 1537- Started Injecting freshwater into reactor vessel 27 MAR Pooled water is being transported to the condenser 31 MAR 0920 Moved the water from the trench 31 MAR -2 APR Move water from condenser tank to surge tank 6 APR 2230 Injected Nitrogen to prevent hydrogen explosion Spent Fuel Pool Hose Ops: 31 MAR 1303-1604	14 MAR 1634 Seawater Pumped 15 MAR 0000 Vented Reactor 17 MAR, Power Cable Restoration starts 25 MAR 1930- Injected Seawater into reactor vessel 26 MAR 1010 Injection of fresh water into reactor vessel 27 MAR Preparations being made to transfer pooled water to the condenser 29 MAR 1630 Started adding freshwater to Spent Fuel Pool 29 MAR- 1 APR Started moving contaminated water from condenser tank to surge tank 2 APR 1625Poured concrete into pit to stop contaminated water leak **2 APR 1710 Moved water from condenser to condenser tank** **3 APR Poured complex molecular polymer into reactor 2 pit** **5 APR 1507 Poured liquid glass chemicals in ground to stop leak around the pit** **6 APR 0538 Confirmed that the leak has stopped** Spent Fuel Pool Hose Ops: 20 MAR 1505-1720 22 MAR 1619-1701 25 MAR 1030-1219 30 MAR 1905-2350 1 APR 1456-1705 4 APR 1105-1337	13 MAR 0841 Vent Reactor 13 MAR 1312 Seawater/Boric Acid Pumped 21 MAR 1601 Workers evacuate from smoke 23 MAR 1620 black smoke. Workers temporarily evacuated, 25 MAR 1802- Inject Freshwater into reactor vessel 28 MAR 1740 Start Move of Basement Water to Surge Tank Hose Ops of spent fuel pool: SDF: 17 MAR water disposal 18 MAR 1400-1438 FD: 19 MAR 1446-20th 0340 20 MAR 2130-21st 0358 22 MAR 1510-1600 25 MAR 1328-1600 TEPCO: 27 MAR 1234-1436 29 MAR 1417-1818 2 APR 0952-1254 4 APR 1703-1919 Spent Fuel Pool: 23 MAR 1103-1320 24 MAR 0530-1605 31 MAR 1630-1933	17 MAR Power restoration effort) 22 MAR 0600-1000 Setup of the water truck "Kirin" 25 MAR 0605 Seawater added to Spent Fuel Pool 27 MAR Transfer of pooled water to the condenser is under consideration Hose of spent fuel pool: SDF: 20 MAR 0820-0943 20 MAR 1822-1943 21 MAR 0637-0841 TEPCO: 20 MAR 0820-0943 20 MAR 0820-0943 20 MAR 1822-1943 21 MAR 0637-0841 22 MAR 1717-2032 23 MAR 1000-1302 24 MAR 1436-1730 25 MAR: 1905-2207 27 MAR: 1655-1925 30 MAR: 1404-1833 1 APR 0828-1414 5 APR 1735-1822 Spent Fuel Pool: 25 MAR 0605-1020 3 APR 1714-2216	18-19 MAR Release Hydrogen from ceiling 19 MAR 0500 Reactor 5 pump activated 19 MAR 0742 Generator activated for reactor 5/6 19 MAR Restarting cooling pump of the reactor 5/6 spent fuel pool. →Temperature Decline 22 MAR 1941 Reactors 5, 6 on External Power

Red: Updated Information Blue: Unreleased New Information **Source: Nuclear Powerplant Disaster Response Headquarters**

Nuclear Reactor Overview (6 APR)

Reactor 1, 2, 3 parameters are stable.

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			Reactor 1	Reactor 2	Reactor 3	Reactor 4
Reactor	Freshwater Injection		○(Intake Pipes)	○(Fire Pipes)	○(Fire Pipes)	Under Maintenance during earthquake/ tsunami
	Reactor Temp Reactor Pressure Containment Structure Press.		211.2℃ 0.350MPaG 0.150MPaabs (6日1800)	143.6℃ -0.014MPaG 0.100MPaabs (6日1800)	83.0℃ 0.004MPaG 0.1066MPaabs (6日1800)	
Spent Fuel Pool	Freshwater by External Pump		○	○	○	—
	Temp	NPP Gauges	×	51.0℃ (4/61800)	×	×
		MOD Thermograph	24℃ (4/6 0730)	—	60℃ (4/6 0730)	57℃ (4/6 0730)
	Hose Ops	Most Recent	3/31 1303～1604	—	4/4 1703～1919	4/5 1735～1822
		Plans	No Plans	—	4/6 1700～1930	No Plans
Water Drainage	Most Recent		4/3 1355～ H/W→CST in progress	4/2 1710～ H/W→CST in progress	4/6 H/W→CST planning	Under Consideration
	Plans		4/7 Same as above	4/7 Same as above (until 4/9)		—

T/B: Turbine Building
CST: Condensed Water Storage Tank
R/W: Radioactive Waste Processing Facility
H/T: Condenser
SPT: Pressure Suppression Tank

Source: Nuclear Disaster Response HQ 7

Fukushima Daiichi NPP Status (Radiation Levels) 7 APR

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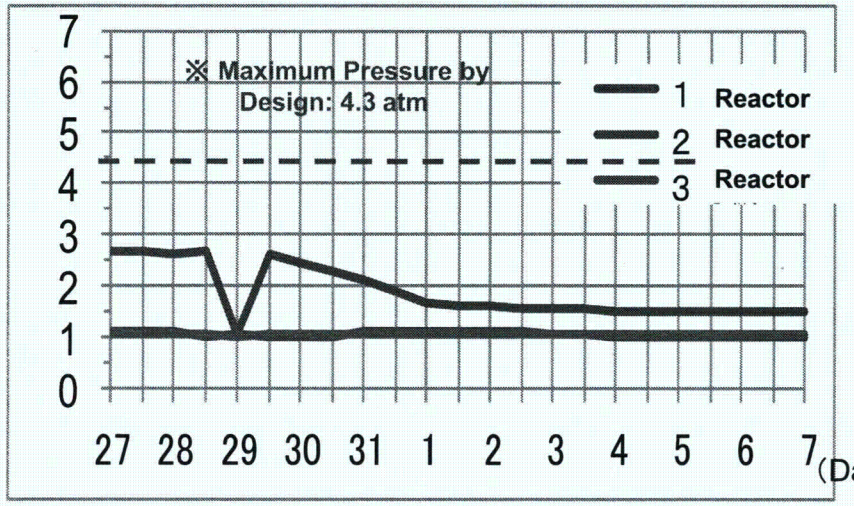
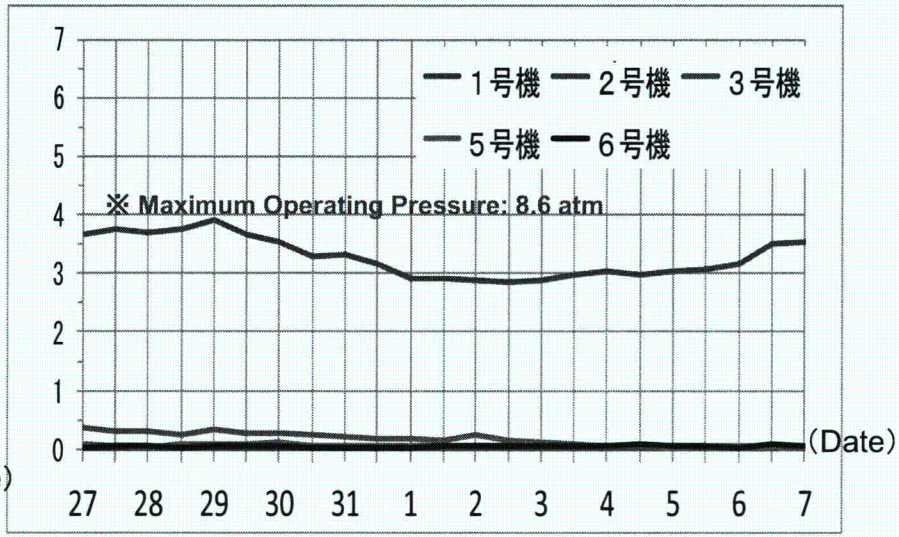
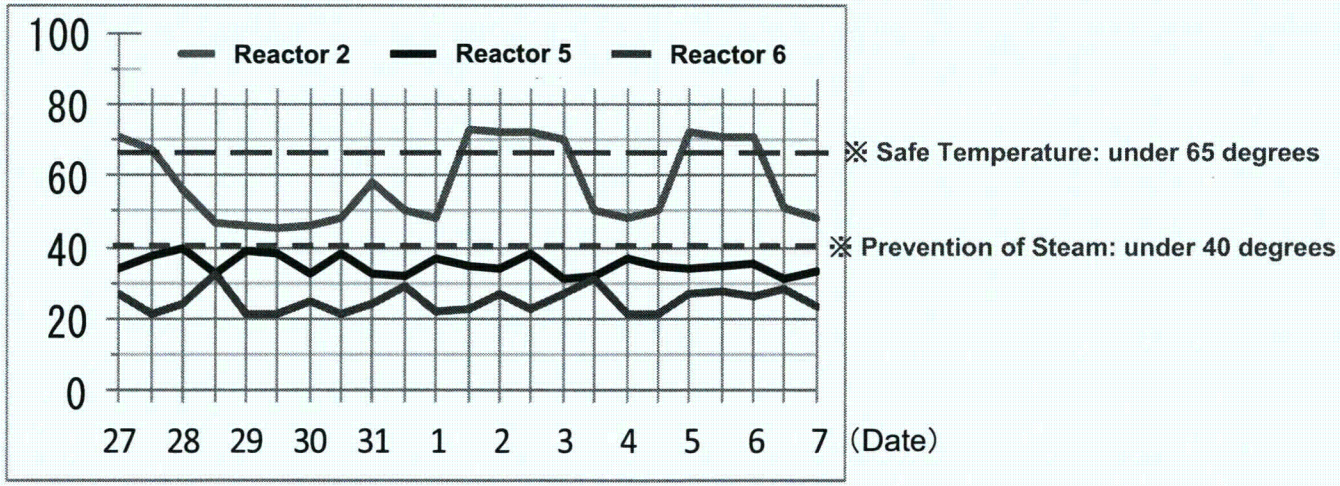
Containment Structure Pressure (4/7 0000)



Reactor Vessel Pressure (4/7 0000)



Spent Fuel Pool Temp (4/7 0200)



Source: MOD DR HQ

Fukushima Daiichi Monitoring Results

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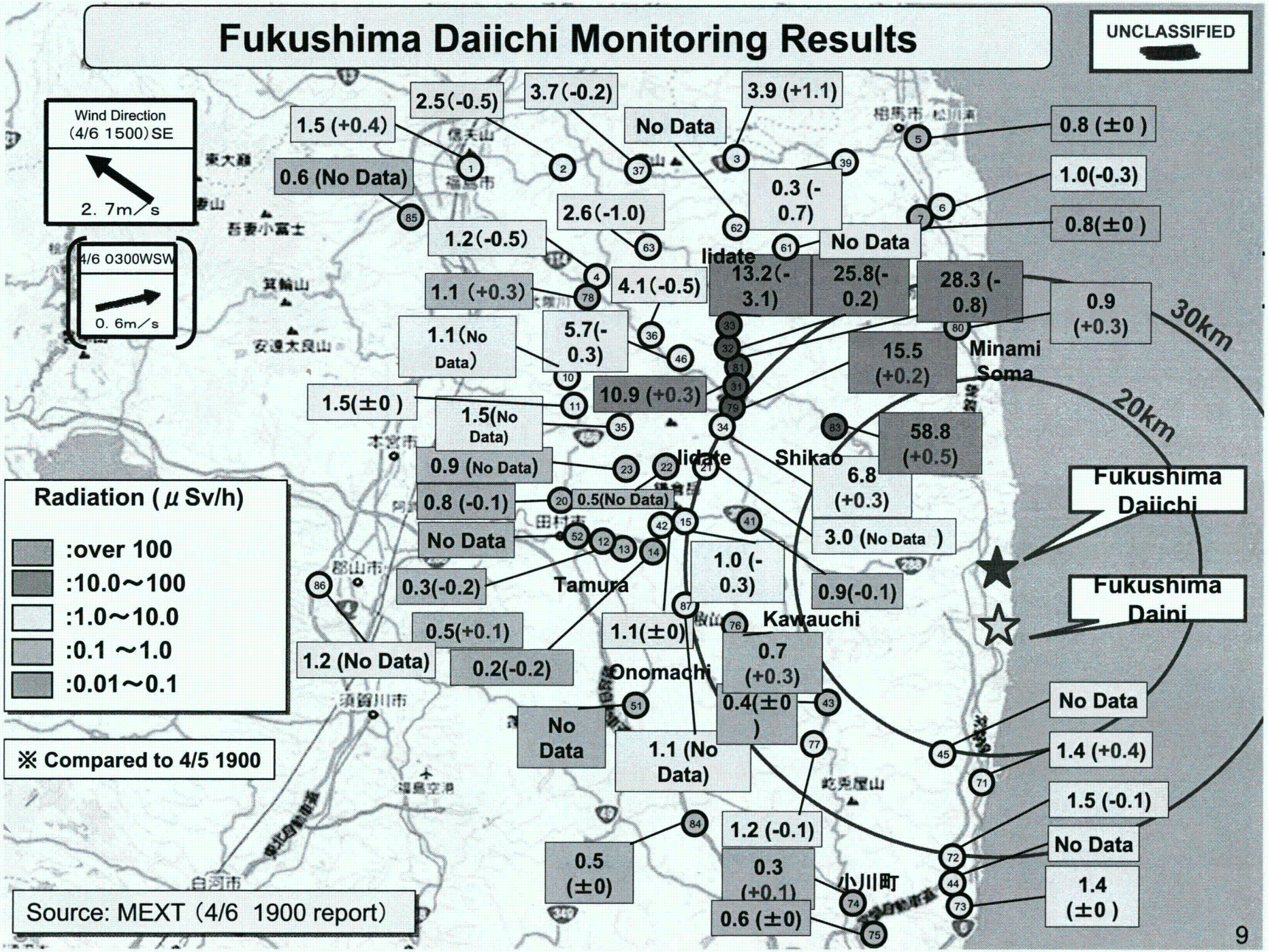

Fukushima Daiichi NPP Accumulated Radiation

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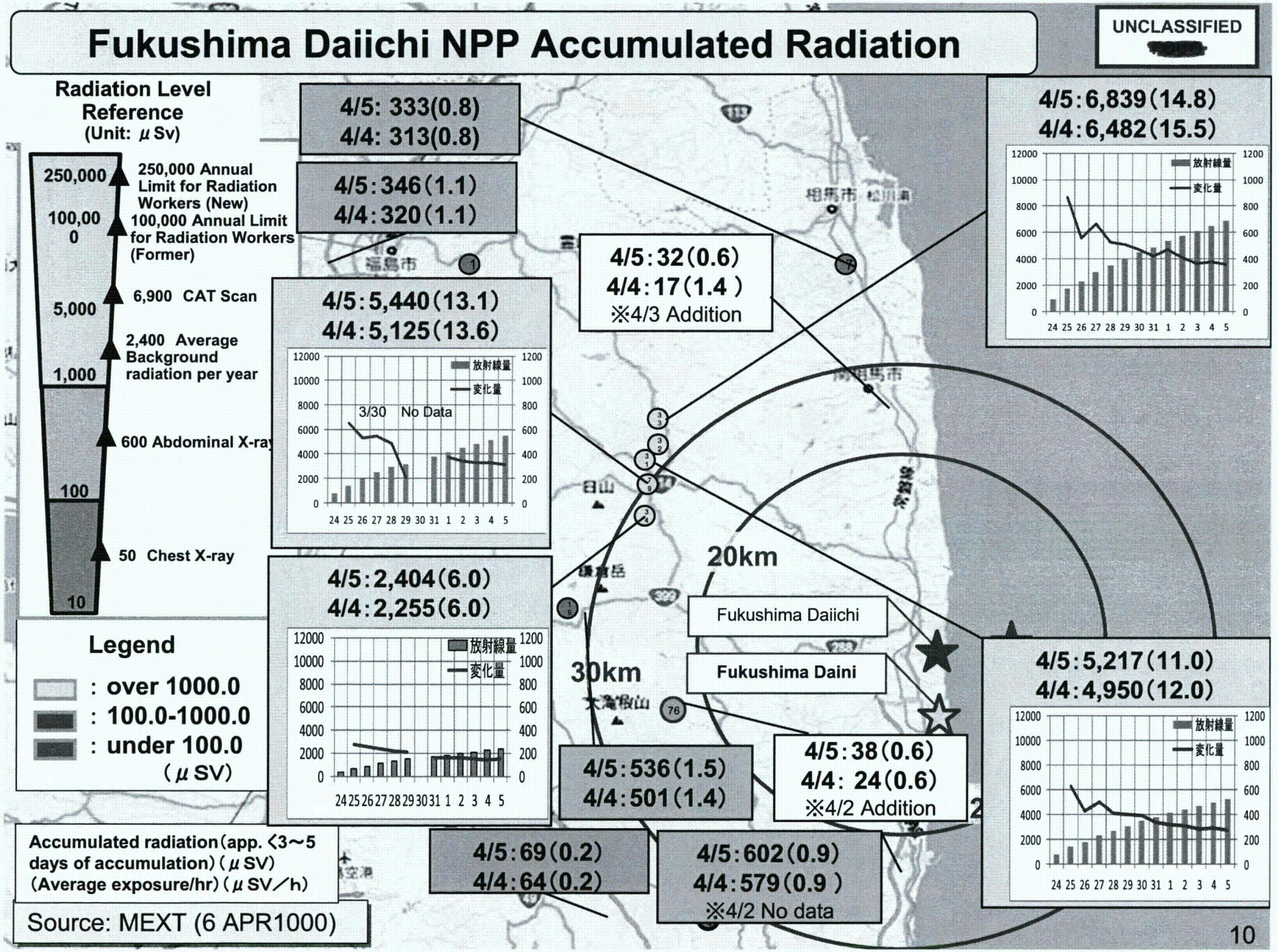

Accumulated radiation (app. <3~5 days of accumulation) (μ SV)
(Average exposure/hr) (μ SV/h)

Source: MEXT (6 APR1000)

Fukushima Daiichi NPP Monitoring 4/7 0500

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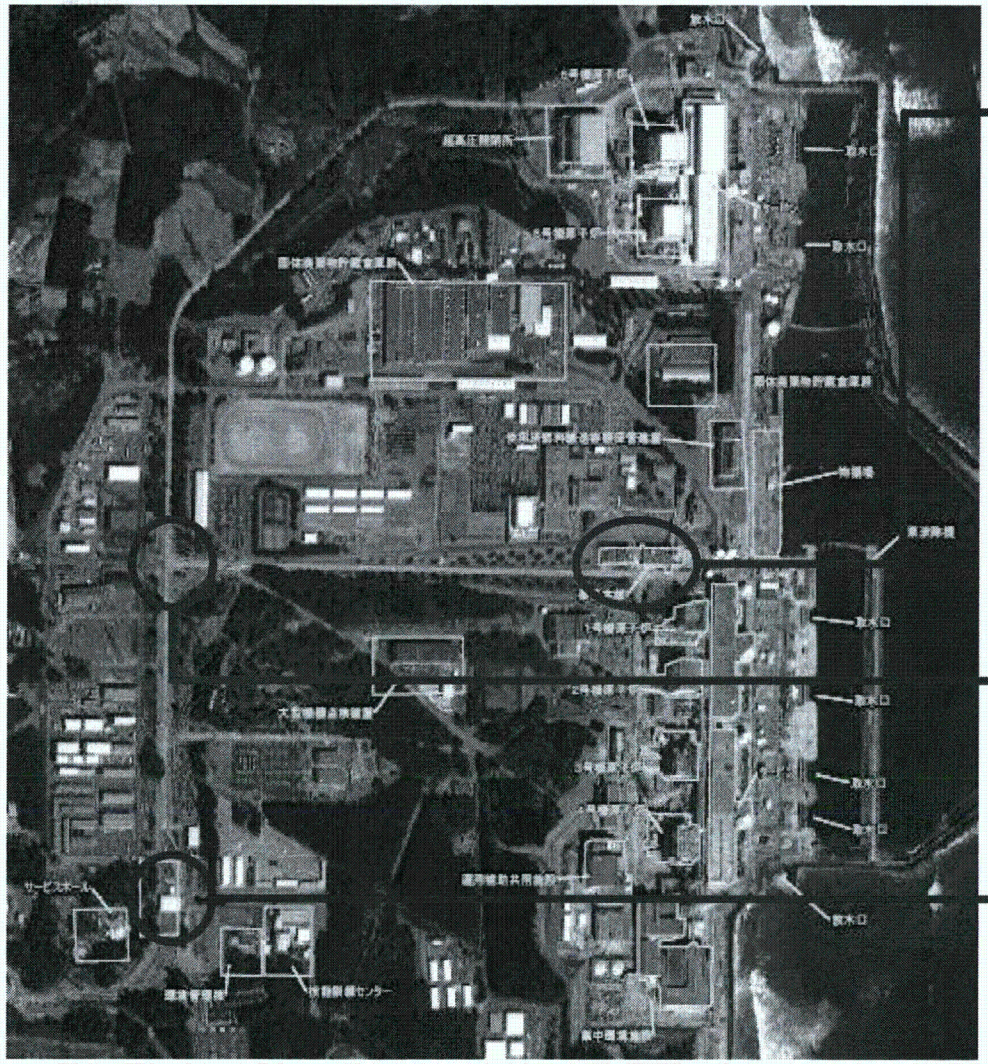

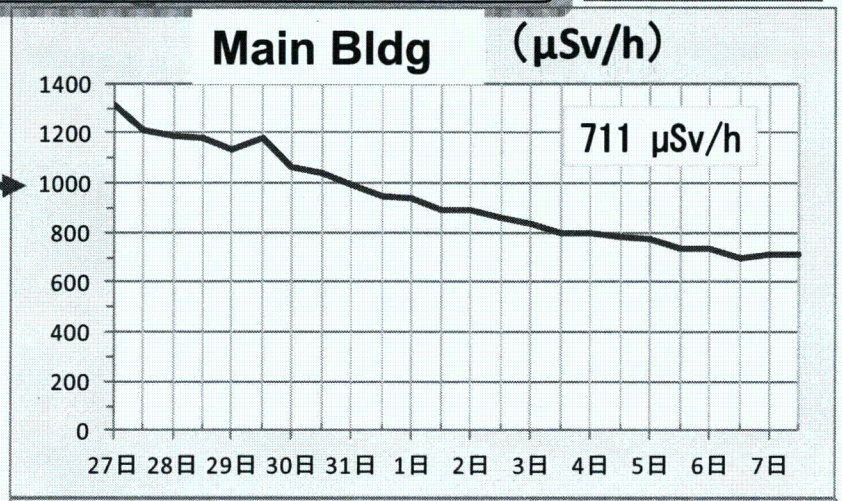

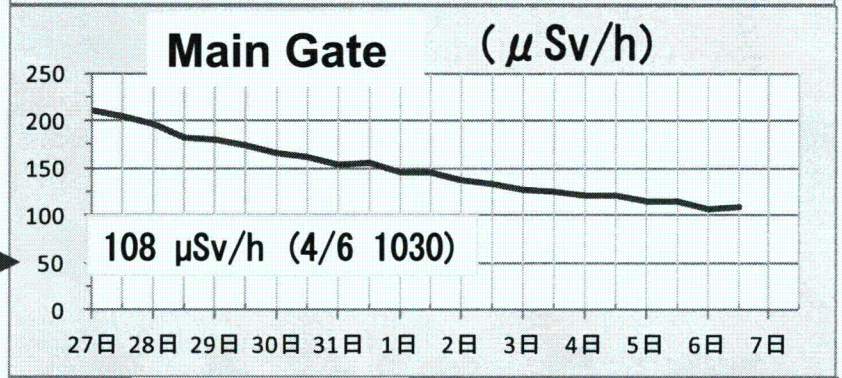

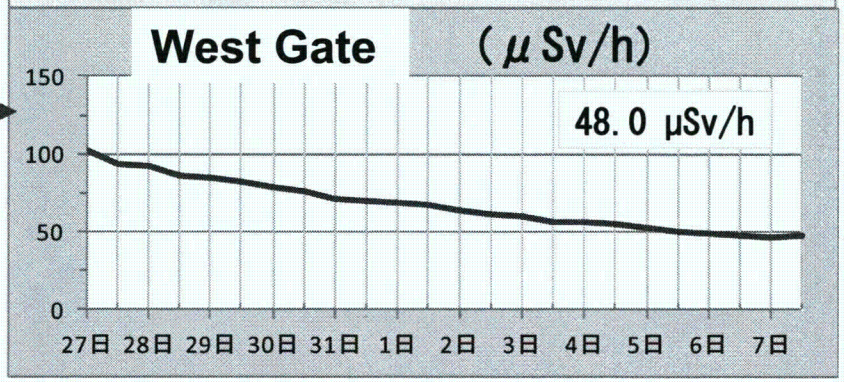

Source: MOD DR HQ

Fukushima Daiichi NPP Radiation of Nearby SDF Facilities 4/6 0600

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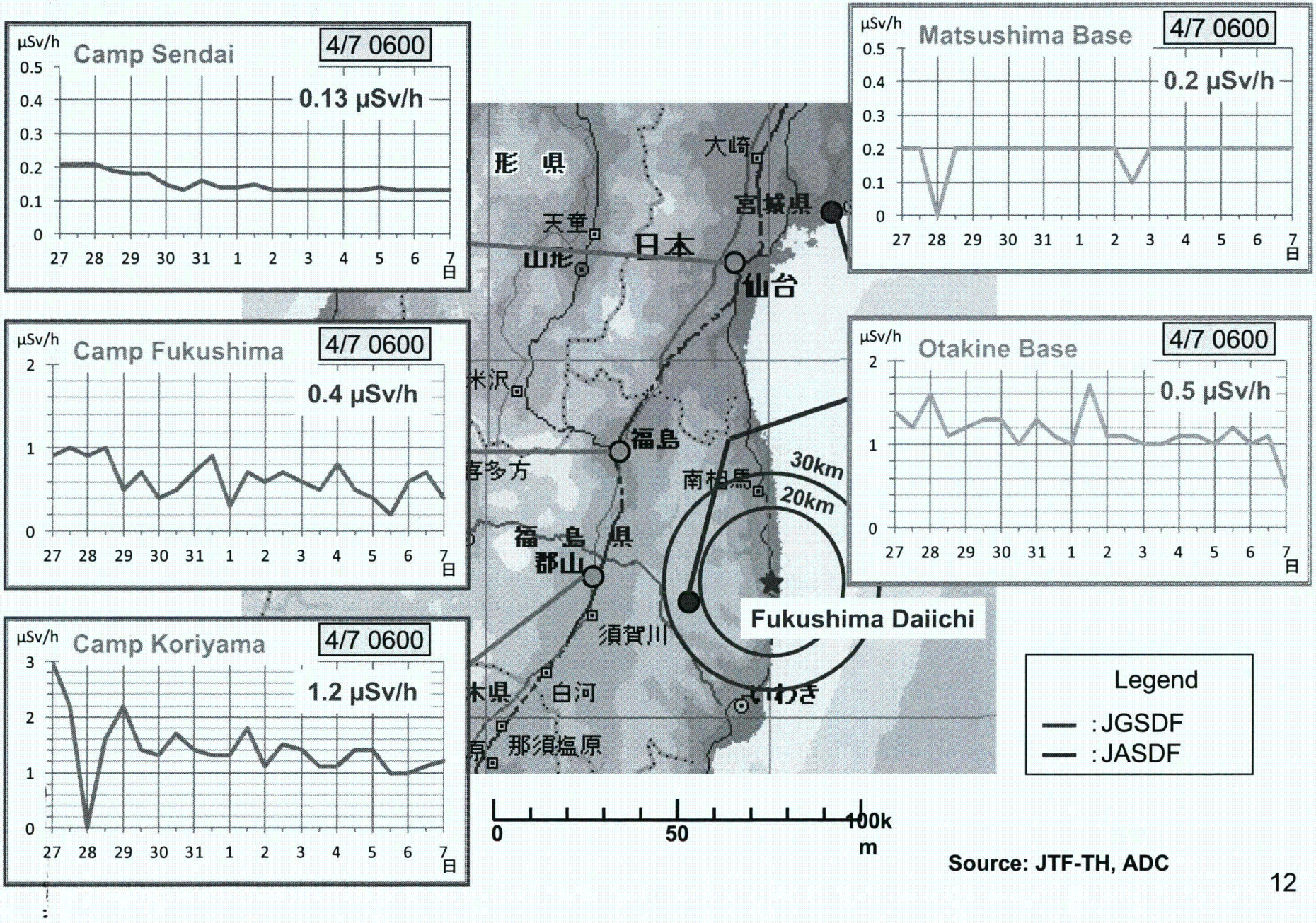

Source: JTF-TH, ADC

Radiological Measurements of DECON Centers (4/5 1700)

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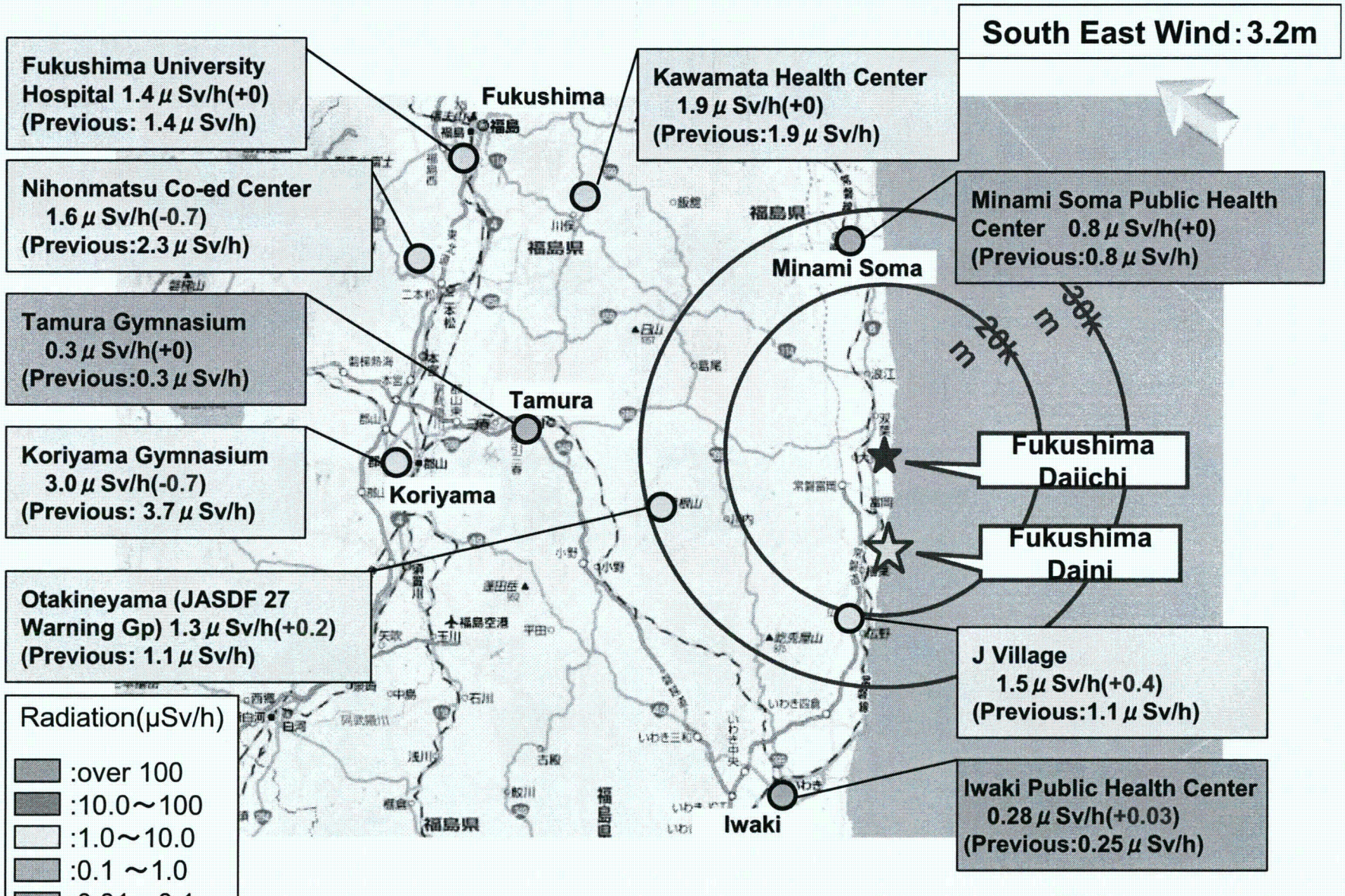

Source: JTF-TH

Radiation Measurements 4/7 0600

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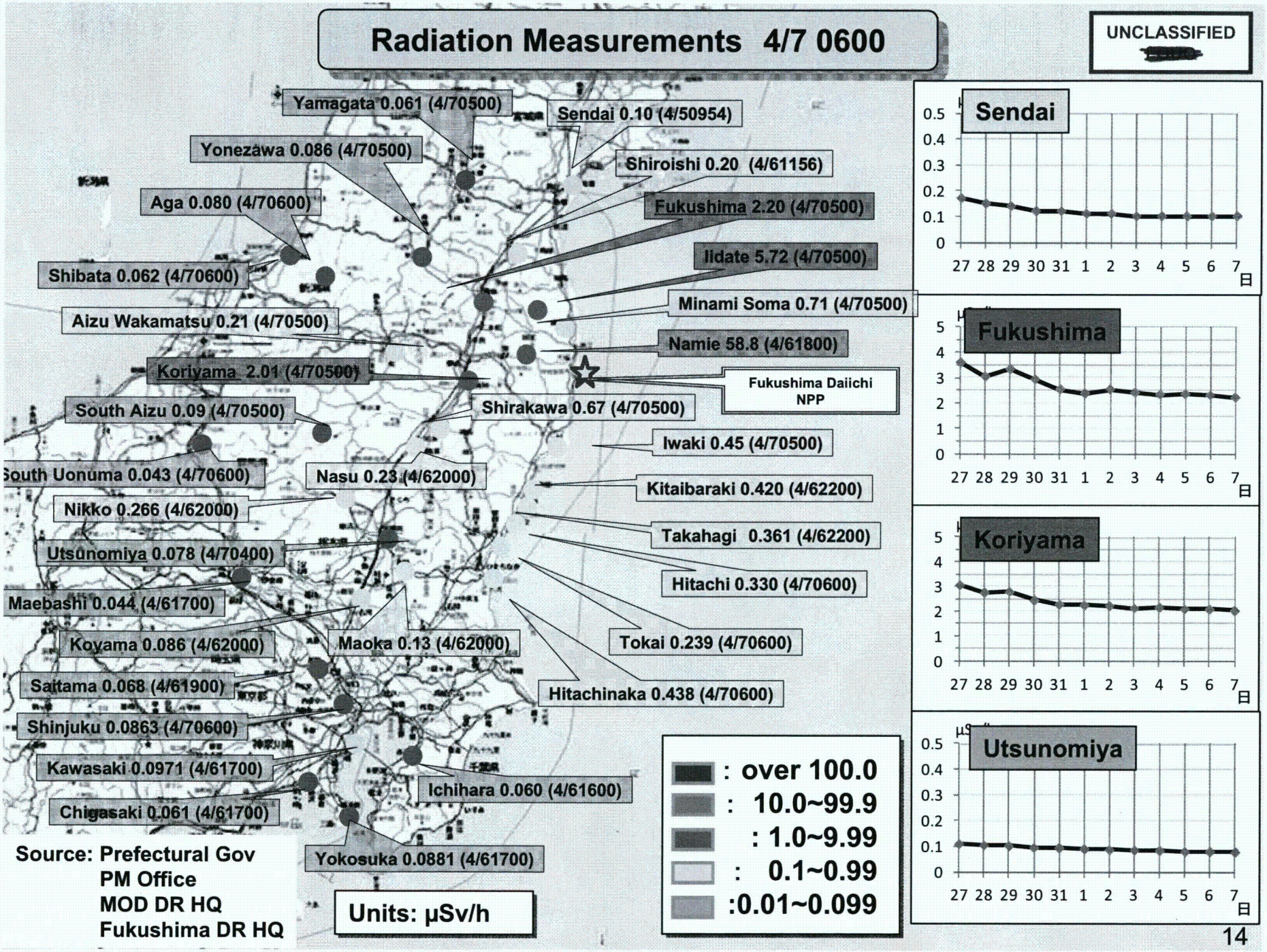
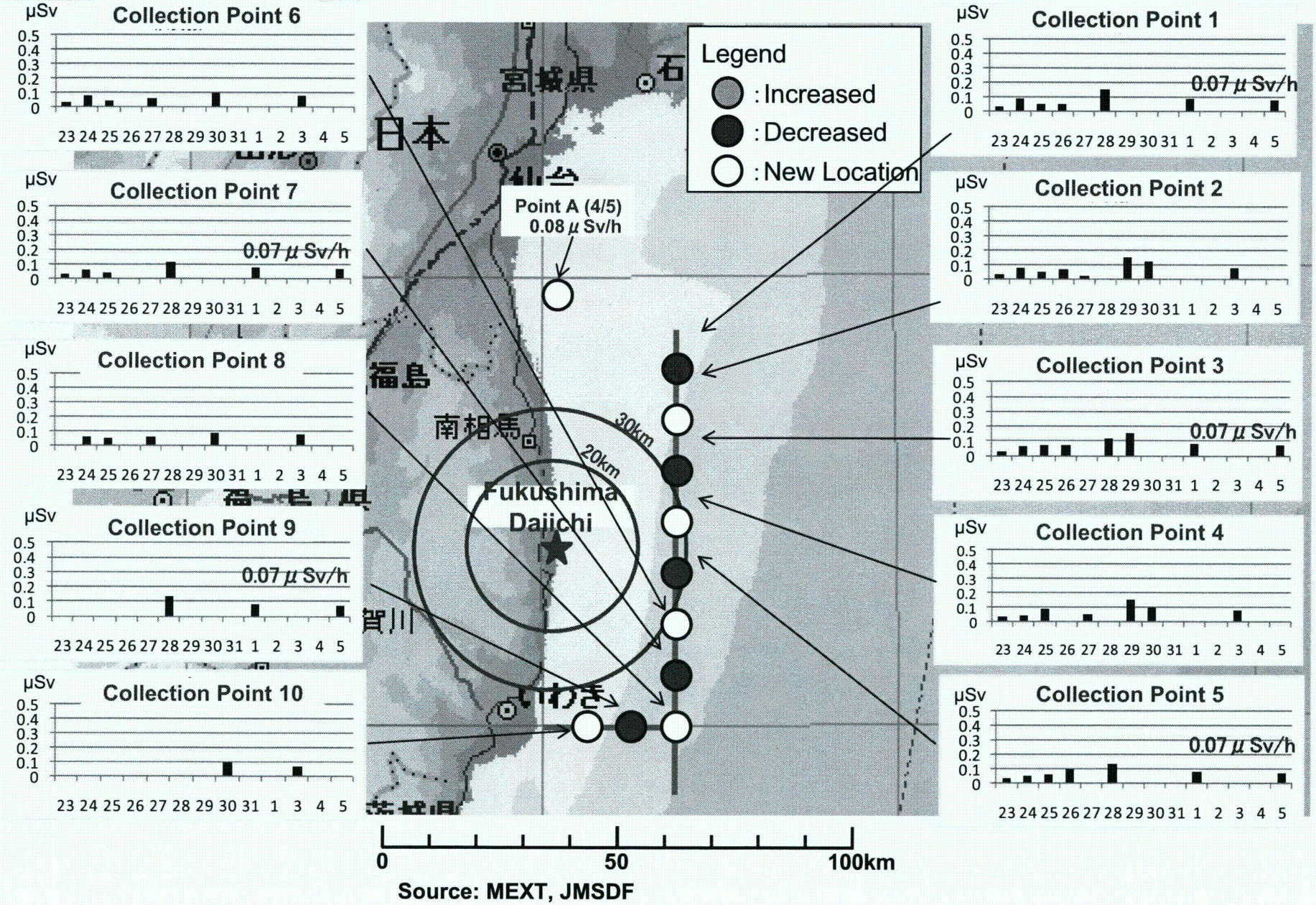


Source: Prefectural Gov
PM Office
MOD DR HQ
Fukushima DR HQ

Units: μSv/h

Fukushima Daiichi Sea Water Radiation Monitoring (30km out)

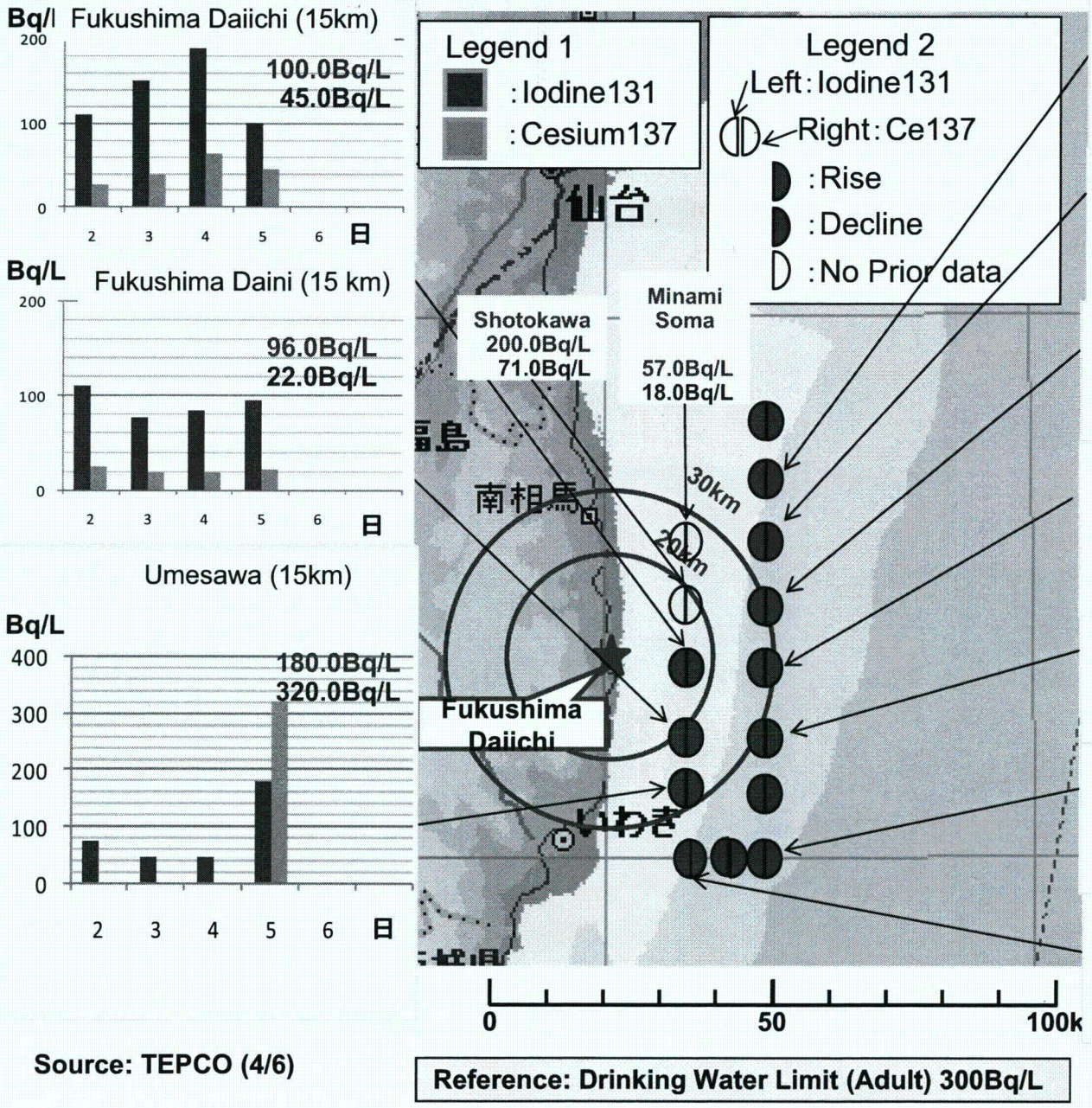
UNCLASSIFIED

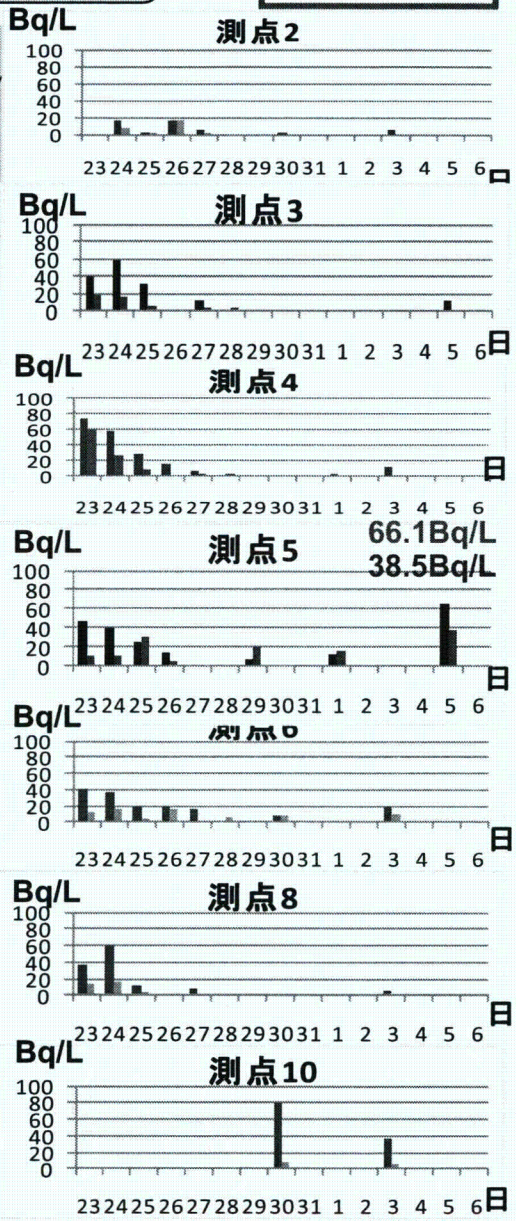


Source: MEXT, JMSDF

Fukushima Daiichi Sea Monitoring (Radiation Levels)

UNCLASSIFIED





Source: TEPCO (4/6)

Reference: Drinking Water Limit (Adult) 300Bq/L

Source: MEXT (4/6)

Lifeline Status

UNCLASSIFIED

#s in ( ) show difference from 4 APR 1130

Estimate of Restoration

- ◇ Respective local government and business entities are surveying the area and preparing estimates

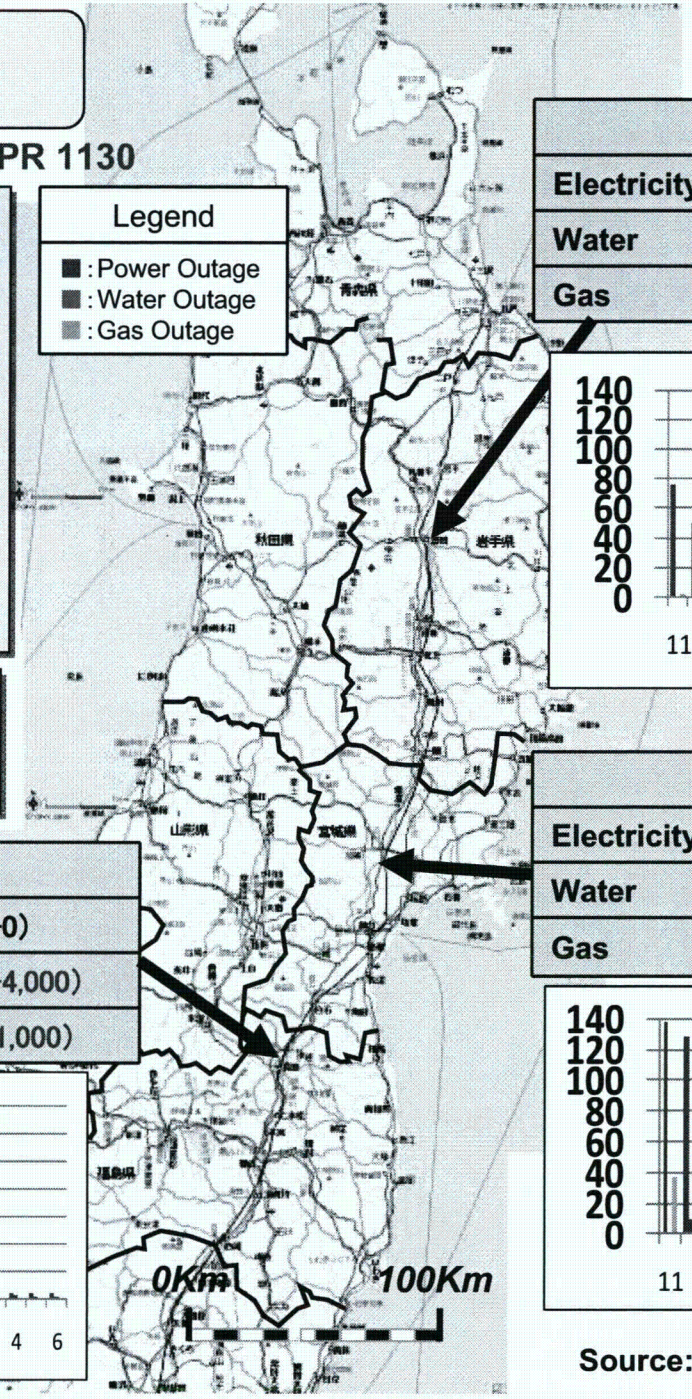
Reference:

Hanshin-Awaji Great Earthquake Lifeline Restoration
Electricity: 7 days
Phone Services: app. 2 weeks
Gas, Sewage: app. 3 months

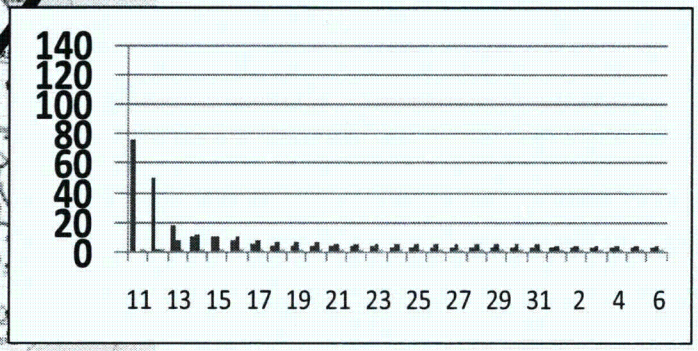
(Source: Hyogo Prefecture Archives)

Communications

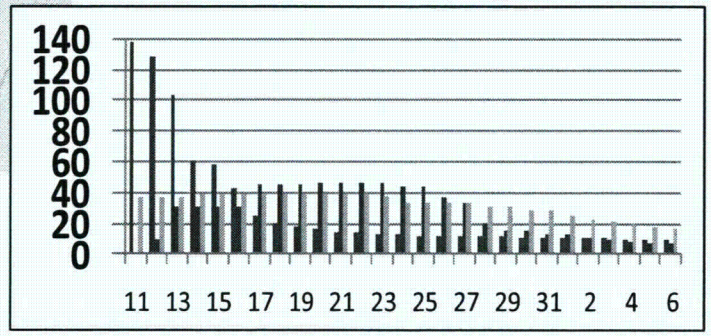
- ◇ Phone line: Mostly Restored
- ◇ Cell Phone: Mostly Restored



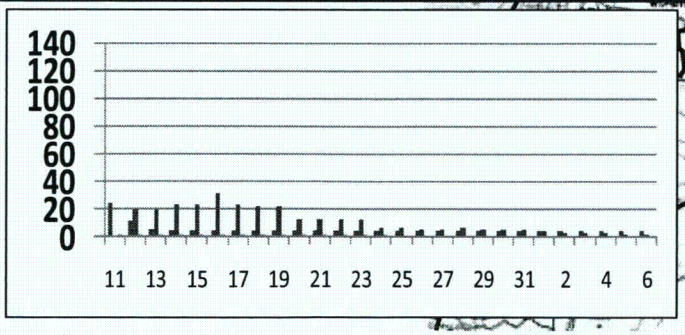
Iwate	
Electricity	Outage: 30,000 homes (+0)
Water	Outage: 40,000 homes (+0)
Gas	Outage: 3,000 homes (-1,000)



Miyagi	
Electricity	Outage: 97,000 homes (−2,000)
Water	Outage: 72,000 homes (−3,000)
Gas	Outage: 162,000 homes (−19,000)



Fukushima	
Electricity	Outage: 36,000 homes (+0)
Water	Outage: 20,000 homes (−4,000)
Gas	Outage: 4,000 homes (−1,000)



Source: METI, MLHW, TEPCO, Gas Assoc.